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NATIONAL DAM SAFETY PROGRAM. HARMAN'S FARM POND DAM (MO 30150),--ETC(U)
MAY 80 R J KIMBALL, J T HOCKENSMITH DACW43-79-0034

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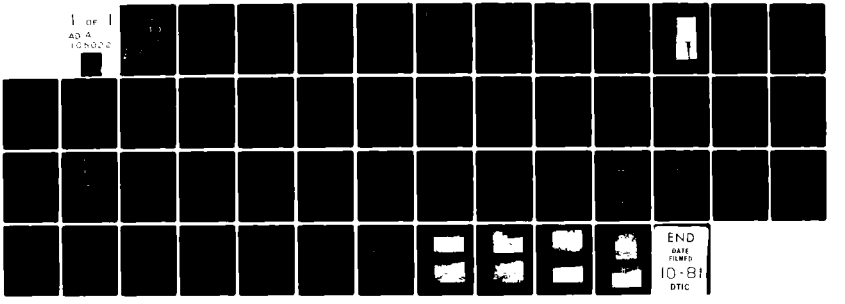

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HARMAN'S FARM POND DAM

ST. FRANCOIS COUNTY, MISSOURI

MO 30150

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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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HARMAN'S FARM POND DAM

ST. FRANCOIS COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30150

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PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY

L. ROBERT KIMBALL AND ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS
EBENSBURG, PENNSYLVANIA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

MAY 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Harman's Farm Pond Dam Phase I Inspection Report

This report presents the results of field inspection and evaluations of Harman's Farm Pond Dam (MO. 30150).

This report was prepared under the National Program of Inspection of Non-Federal Dams.

Harman's Farm Pond Dam has been classified as unsafe, non-emergency by the St. Louis District because the spillway will not pass 50% of the PMF.

SUBMITTED BY: SIGNED
Chief, Engineering Division — 14 MAY 1980 Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer — 15 MAY 1980 Date

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guildelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM	Harman's Farm Pond
STATE LOCATED	Missouri
COUNTY LOCATED	St. Francois
STREAM	Unnamed Tributary to West Fork
DATE OF INSPECTION	October 19, 1979

Harman's Farm Pond Dam was inspected using the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of federal and state agencies, professional engineering organizations, and private engineers. The resulting guildelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high-hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The dam is in the small size classification since it is greater than 25 feet high, but less than 40 feet high with a storage capacity less than 1000 acre-feet but more than 50 acre-feet. The estimated damage zone extends approximately 3/4 miles downstream of the dam. Within this damage zone are approximately 6 dwellings and Laguna Palma Dam (MO 30404).

Based on the downstream affected area the Spillway Design Flood for this dam is the PMF (Probable Maximum Flood). The spillway is capable of controlling approximately 21% of the PMF without overtopping the embankment. The ability of the spillway, at Harman's Farm Pond Dam, to pass the the 100 year storm is marginal.

Deficiencies visually observed for Harman's Farm Pond Dam include no riprap on the upstream slope, trees and brush on the embankment slopes and in the spillway, wet area at the toe of the embankment, two animal burrows and no means to drain the reservoir. There is neither a warning system in effect nor a safety inspection program. Stability and seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" are not available which is considered a deficiency. These deficiencies should be remedied at the direction of a professional engineer knowledgeable in the design and construction of earthfill dams. No deficiencies were observed regarding sliding, cracking, settlement or sinkholes. No seepage or erosion were noted during the inspection. Maintenance of the dam is considered poor.

HARMAN'S FARM POND DAM - MO. 30150

O.T. McCONNELL
Hydraulic Engineer

JAMES T. HOCKENSMITH
L. Robert Kimball & Associates
Geologist

R. JEFFREY KIMBALL, P.E.
L. Robert Kimball & Associates
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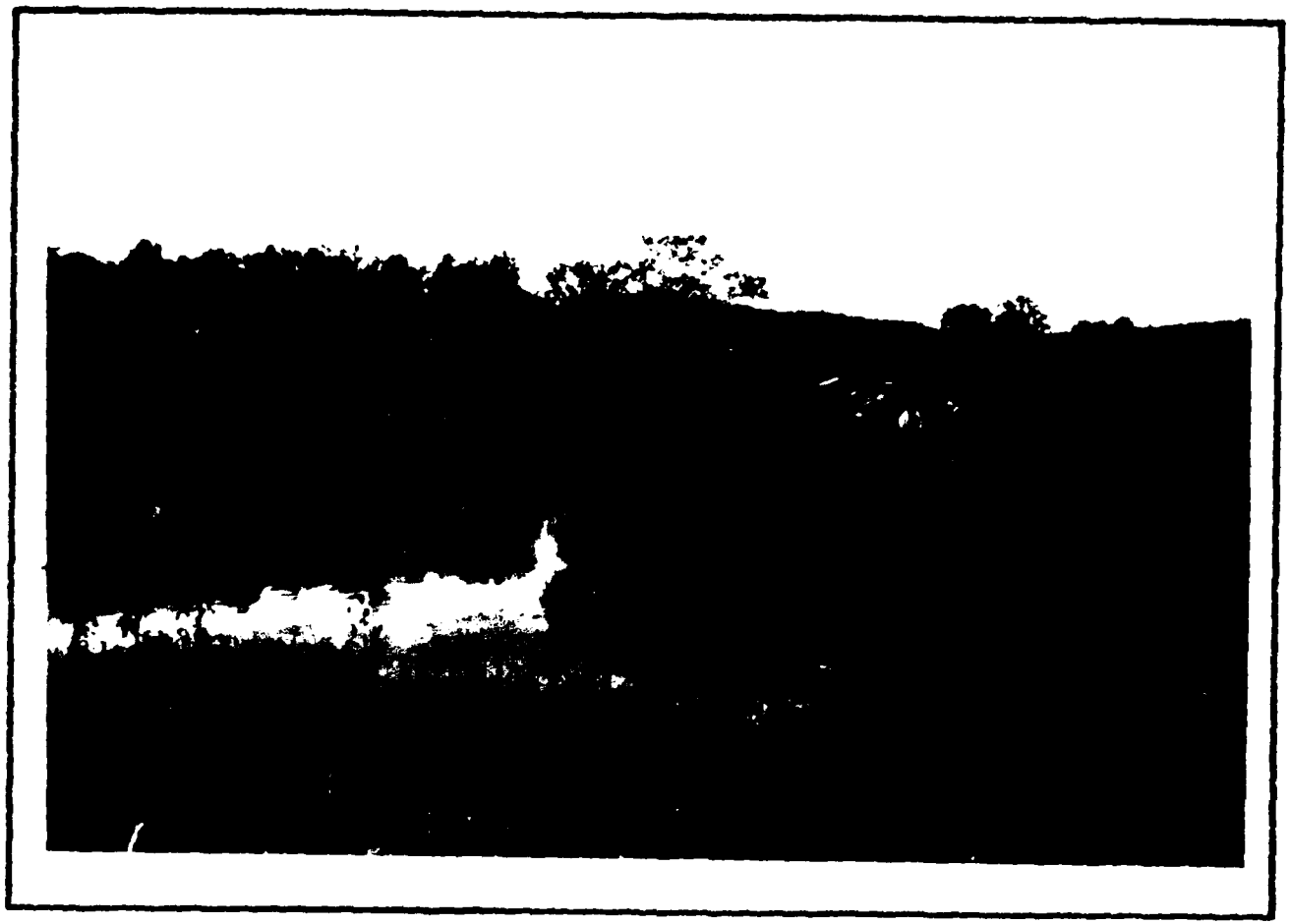

Photograph No. 1. Overview of upstream slope of dam.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
HARMAN'S FARM POND DAM - I.D. NO. 30150

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Harman's Farm Pond Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general conditon of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. Harman's Farm Pond Dam is an earthfill dam, approximately 342 feet long and 31.5 feet high. The embankment is a cross valley earthfill dam which impounds water to a normal elevation of approximately 650.7 feet. The upstream slope is unprotected against wave action (no riprap). The upstream slope varies from 2.5H:1V to 3H:1V. The downstream slope is 2.5H:1V. The crest width is 10 feet.

The spillway is located near the right abutment (viewing downstream). The spillway channel bottom at the control section is approximately 16 feet wide and is cut into bedrock. The control section is located approximately 25 feet downstream from the centerline axis of the dam. The control section is trapezoidal shaped with an average side slope of 1.5H:1V. Further downstream the side slopes of the spillway channel become almost vertical. There is no emergency spillway at Harman's Farm Pond Dam.

b. Location. Harman's Farm Pond Dam is located approximately 3.6 miles southeast of Valles Mines, Missouri on a tributary of the West Fork of Plattin Creek. The dam can be located (Section 1, Township 38 North, Range 5 East) on the Halifax, Missouri 7.5 minute U.S.G.S. quadrangle.

c. Size Classification. Harman's Farm Pond Dam is a small size structure (31.5 feet high, 51 acre-feet).

d. Hazard Classification. Harman's Farm Pond Dam is a high hazard dam. Downstream conditions indicate that loss of life is probable should failure of the dam occur. The estimated hazard zone extends approximately 3/4 miles downstream of the dam. Within the hazard zone are 6 dwellings and Laguna Palma Dam (MO. 30404).

e. Ownership. Harman's Farm Pond Dam is owned by Mr. Morris Harman. Correspondence should be addressed to:

Mr. Morris Harman
9955 Mahogany Court
St. Louis, MO 63123
(314) 631-4010

f. Purpose of Dam. Harman's Farm Pond Dam is used for recreation.

g. Design and Construction History. Based on an interview with the owner's son, Mr. Chris Harman, who designed the dam, and a letter written by the owner, the dam was built in the spring of 1967. The owner reported that the dam was constructed by the H.F. Gegg Construction Company of Ste Genevieve, Missouri. No design drawings, reports or construction history exists.

h. Normal Operating Procedures. No operating records exist. During an interview with the owner's son, it was reported that the spillway is occasionally blocked. The spillway blockage is cleared with a tractor when needed.

1.3 PERTINENT DATA

a. Drainage Area. 0.26 square miles
U.S.G.S. quadrangle

b. Discharge at Damsite (cfs).

(1) Maximum known flood at dam site	Unknown
(2) Spillway capacity at top of dam	360

c. Elevation (feet) - Field survey based on assumed spillway crest elevation of 650.7 feet estimated from aerial photographs supplied by the St. Louis District, Corps of Engineers and U.S.G.S. 7.5 minute Halifax quadrangle.

(1)	Top of dam (low spot)	654.1
(2)	Spillway crest	650.7
(3)	Normal pool	650.7
(4)	Maximum pool (PMF)	656.5
(5)	Tailwater on day of inspection	None
(6)	Streambed at centerline of dam	622.5

d. Reservoir (feet).

(1)	Length of maximum pool	1200
(2)	Length of normal pool	1000

e. Storage (acre-feet).

(1)	Top of dam	70
(2)	Spillway crest	51
(3)	Normal pool	51
(4)	Maximum pool (PMF)	85

f. Reservoir Surface (acres).

(1)	Top of dam	6
(2)	Spillway crest	5
(3)	Normal pool	5
(4)	Maximum pool (PMF)	7

g. Dam.

(1)	Type	Earthfill
(2)	Length	342 feet
(3)	Height	31.5 feet
(4)	Top width	10 feet
(5)	Side slopes	Upstream - 2.5H:1V to 3H:1V Downstream - 2.5H:1V

h. Spillway.

(1)	Type	Open Cut
(2)	Length (bottom)	16 feet
(3)	Crest elevation	650.7 feet
(4)	Upstream channel	Open cut in earth and rock
(5)	Downstream channel	Open cut in rock to unnamed tributary
(6)	Control Section Shape	Trapezoidal

i. Drawdown Facilities. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN. No design drawings, reports or data are known to exist as reported by the owner.

2.2 CONSTRUCTION. Based on information supplied by the owner's son it was reported that the dam was built in the spring of 1967. No information exists on the construction of the dam.

2.3 OPERATION. No operating records exist.

2.4 EVALUATION.

a. Availability. There are no engineering data available.

b. Adequacy. The field surveys and visual inspection presented herein are considered adequate to support the conclusion of this report. "Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record."

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. The onsite inspection of Harman's Farm Pond Dam was conducted by personnel of L. Robert Kimball and Associates on October 19, 1979. The inspection team consisted of a hydrologist, structural/soils engineer and a geologist. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments, and toe.
2. Examination of the spillway facilities, exposed portions of any outlet works, and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.

b. Project Geology. The bedrock underlying Harman's Farm Pond Dam consists primarily of the Roubidoux formation which is part of the Candian series of the Ordovician System. The Gasconade formation underlies the Roubidoux formation and probably forms the rock under the dam itself.

The Roubidoux formation contains sandstone, dolomitic sandstone and cherty dolomite. Except in the central part of the state, the sandstone accounts for little more than 10% of the formation, the remainder consisting mostly of cherty dolomite. The dolomite is light to gray to brown, finely crystalline, and thinly to thickly bedded. The Roubidoux formation ranges in thickness from 100 to 250 feet, but is probably thinner here, since much of it has been eroded away.

The Gasconade is primarly a light brownish-gray cherty dolomite in this area. The lower part of the dolomite is coarsely crystalline and chert often makes up more than 50% of the volume of the rock. The upper part of the dolomite, which is present around Harman's Farm Pond, is finely crystalline and contains much smaller amounts of chert. The chert may be white and porcelain-like or with brown and gray bands. Many of the nearly vertical cliffs in the central Ozarks are formed by the Gasconade. Springs and caves are also common in this formation, which may be from 300 to 700 feet thick.

Only one rock outcrop was observed during the inspection. This was at the discharge end of the spillway and consisted of cherty dolomite. This may be either the Upper Gasconade or the lower Roubidoux. The rock was slightly weathered and exhibited some jointing while the beds were of medium thickness. Solution cavities are often found in these rock types, but no evidence of karst terrain was observed in the vicinity. It is difficult

to distinguish any more detailed information on the basis of one brief inspection with only one outcrop. The published literature contains only minimal information concerning these two formations.

Structural features in the vicinity of Harman's Farm Pond Dam include the Plattin Creek anticline, the axis of which passes the lake immediately to the west in a northeast-southwest direction. The axis plunges gently northwards. The eastern limb is slightly steeper, but both limbs are reported as gently dipping (no dips are given). The Rugley School fault block and fault are another structural feature lying two to three miles south of the lake. A component of the Valles Mines - Vineland fault zone which is, in turn, a part of the Ste. Genevieve fault system, the Rugley School fault is the largest of a series of faults bounding the Rugley School fault block. This is an untilted wedge of sediment marked by faults on the northwest, north and northeast. To the south, however, it merges with the Farmington anticline. The Rugley School fault brings the Davis Shale into contact with Gasconade Dolomite while the other faults have small displacements of only about 75 feet. Some seismic activity is still noted in this part of the state.

c. Dam and Spillway. The visual inspection of the dam indicated that the embankment structure was in fair condition.

From a brief survey conducted during the inspection, it was determined that a low point on the dam is at elevation 654.1. The earth embankment section of the dam generally rises from the spillway section toward the left abutment. The earth embankment section is 342 feet long with a maximum height of approximately 31.5 feet. The upstream slope varies from 2.5H:1V to 3H:1V. The crest width is approximately 10 feet. The downstream slope is approximately 2.5H:1V. The downstream slope is covered with tall grass, weeds, briers and small trees. No seepage or erosion was noted on the downstream slope although two burrows were seen as well as a small water pool at the toe of the embankment. No discharge was visible from the pool during the inspection (See Figure 1 for location).

The spillway is located on the right side of the earthen embankment and is an open cut channel with the bottom cut into bedrock. The spillway and control section is trapezoidal and the exit channel is an open channel cut into bedrock. Spillway discharges cascade over bedrock outcrops beyond the toe of the dam (See Photos No. 8, No. 9). Brush and scattered trees line the spillway and exit channel slopes. There are no drainlines present to lower or drain the reservoir.

d. Reservoir Area. No obvious problems were noted in the reservoir area. The watershed is moderately sloped and wooded.

e. Downstream Channel. The downstream channel is a tributary of the West Fork and travels approximately 500 feet before joining the West Fork of Plattin Creek. Laguna Palma Dam (MO. 30404) lies approximately 3/4 of a mile downstream of Harman's Farm Pond Dam on West Fork.

3.2 EVALUATION. The visual inspection did not reveal any immediate signs of instability. The earth embankment appears to be in fair condition. Both the upstream and downstream slopes are moderate and vegetated. No visible erosion exists and no seepage was noted although a small pond was present at the toe of the dam (See Figure 1). No discharge was detected from the ponded water.

A complete evaluation of the structure cannot be made without a detailed stability and seepage analysis.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES. The reservoir is maintained at or below the spillway crest elevation. No facilities are present to lower or drain the reservoir.

4.2 MAINTENANCE OF DAM. Maintenance of the dam is considered poor. Maintenance in the form of clearing occasional debris from the spillway is conducted when necessary by the owner.

4.3 MAINTENANCE OF OPERATING FACILITIES. No operating facilities are present to be maintained.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT. The owner, reported that no warning system is in effect.

4.5 EVALUATION. Maintenance of the dam is considered poor. There is no warning system in effect to warn downstream residences of large spillway discharges or failure of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. There are no hydraulic or hydrological design data available as discussed in Section 2.

b. Experience Data. Information concerning drainage areas, and watershed characteristics, and storage were obtained from the U.S.G.S. topographic quadrangle. The spillway and dam layout was made from surveys conducted during the inspection. There is no history of the dam having been overtopped.

c. Visual Observations. The spillway is located at the right abutment of the embankment (viewing downstream). The spillway control section is trapezoidal in shape with a bottom width of 16 feet. The spillway exit channel is cut into rock and ultimately outlets over a rock outcrop beyond the toe.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, St. Louis District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydraulic Engineering Center (HEC) U.S. Army Corp of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed in Appendix B.

Complete summary sheets for the computer output are presented in Appendix B. To facilitate review, the major results of the overtopping analysis are presented below:

Peak inflow	3142	cfs
Spillway capacity	360	cfs

Ratio of PMF	Maximum Reservoir Water Surface (ft)	Maximum Depth over Dam (embankment) (ft)	Maximum Outflow, (cfs)	Duration of over topping, (hrs.)
.10	652.69	0.00	153	0.00
.20	654.03	0.00	348	0.00
.30	654.86	0.76	688	0.67
.50	655.60	1.50	1437	1.17
1.00	656.56	2.46	3110	5.17

The Corps of Engineers Spillway Design Flood for a high hazard-small dam is 1/2 PMF to the PMF. Based on the downstream hazard exposure, the Spillway Design Flood for this dam has been selected to be the PMF. The spillway is capable of controlling only approximately 21% of the PMF without overtopping the embankment. Overtopping the embankment for an extended period of time or with depth will cause failure of the dam.

Because of the low spillway capacity, the 100 year storm was routed through the reservoir. It was determined that the spillway is marginally capable of passing the 100 year storm. For the 100 year storm routing the dam was overtopped by 0.11 feet.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations indicate that the dam was in fair condition. No erosion or seepage was noted on the embankment during the inspection. The embankment slopes are moderate and covered with grasses. Ponded water was present at the toe near the right abutment (See Figure 1).

b. Design and Construction Data. No design or construction data is available on the dam. "Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record."

c. Operating Records. No operating records are kept on the structure.

d. Post Construction Changes. No post-construction changes are known for this structure.

e. Seismic Stability. The dam is located in seismic zone 2 to which the guidelines assign a "moderate" damage potential. No seismic stability analysis has been conducted.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The visual observations, review of available data and hydrologic calculations indicate that Harman's Farm Pond Dam's spillway is inadequate. The spillway is capable of controlling approximately 21% of the PMF without overtopping the embankment. In addition, the spillway is marginally capable of controlling the 100 year storm.

The earth embankment appeared to be in fair conditon. No erosion or seepage was noted at the time of inspection. A heavy growth of weeds, briers and small trees was noted on the downstream slope. Ponded water was present at the toe of the dam near the right abutment, although no discharge was visible from the area. "Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record."

b. Adequacy of Information. Complete assessment of the structural stability of the structure cannot be made because of the limited design data and construction data. Stability and seepage analyses comparable to the requirement of the "Recommended Guidelines for Safety Inspections of Dams" were not available, which is considered a deficiency.

c. Urgency. The deficiencies described herein should be corrected promptly. Special note should be made of items in paragraph 7.2 a and b. and these recommendations should be pursued promptly.

d. Need for Phase II. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required, however a Phase II investigation is not required.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Alternatives. A detailed hydraulic and hydrology study should be conducted by a registered professional engineer knowledgeable in dam design to increase the spillway capacity. The study should begin immediately and remedial modifications begun immediately after the study is complete.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures are recommended:

1. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams.

2. The trees and brush which are located on the downstream slope, of the dam should be removed and the animal burrows filled. In addition, the brush and trees located in the spillway should be removed. Clearing of trees and brush from the embankment and spillway should be completed under the direction of a professional engineer experienced in the design and construction of dams.

3. Riprap should be provided on the upstream slope of the dam.

4. Positive drainage should be provided to eliminate the ponded water at the toe of the dam. If the seepage exists, it should be monitored at regular intervals and checked for turbidity (uncontrolled seepage can lead to a piping condition which could result in failure of the dam).

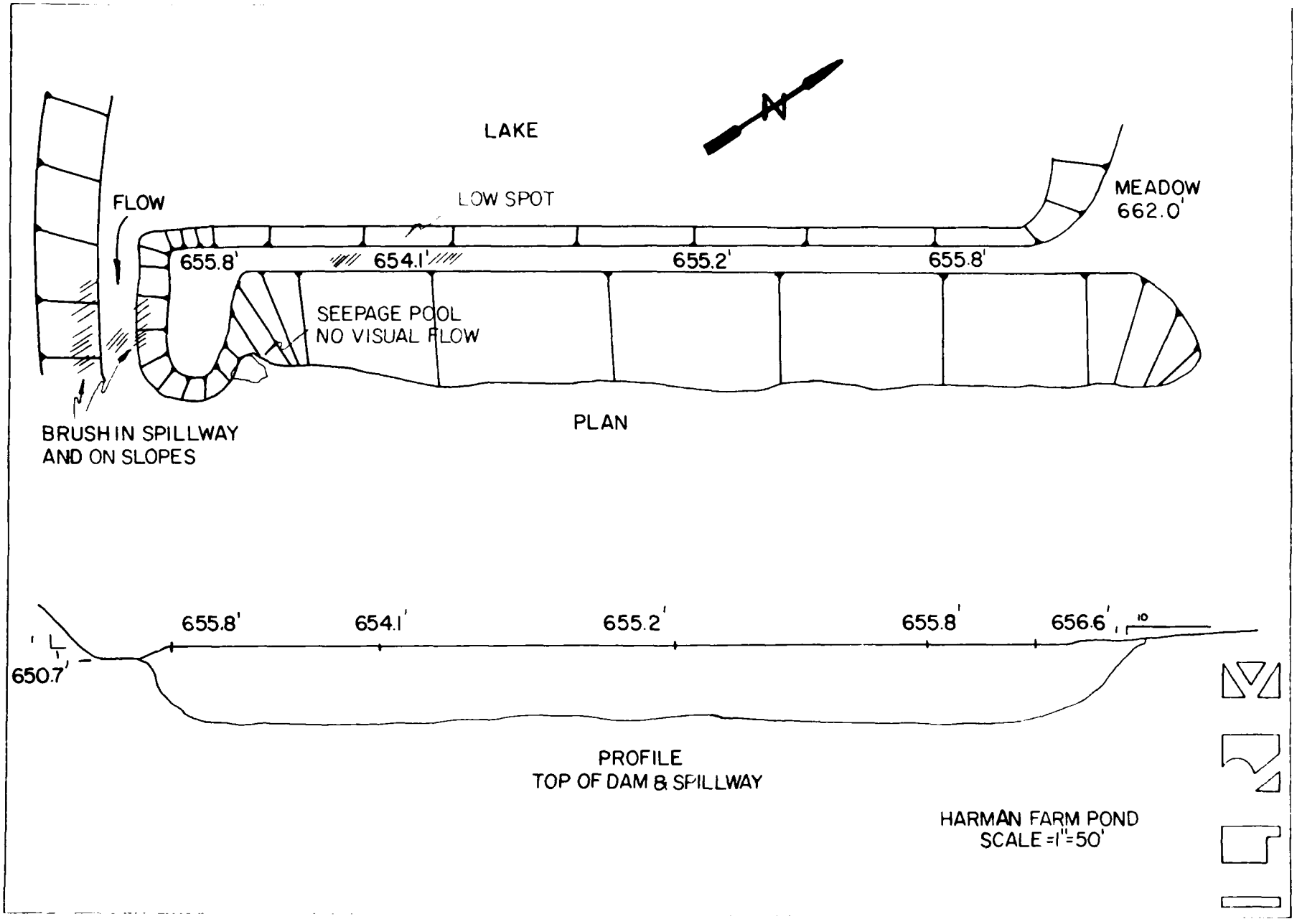
5. A means of draining the lake and regulating the reservoir surface should be provided.

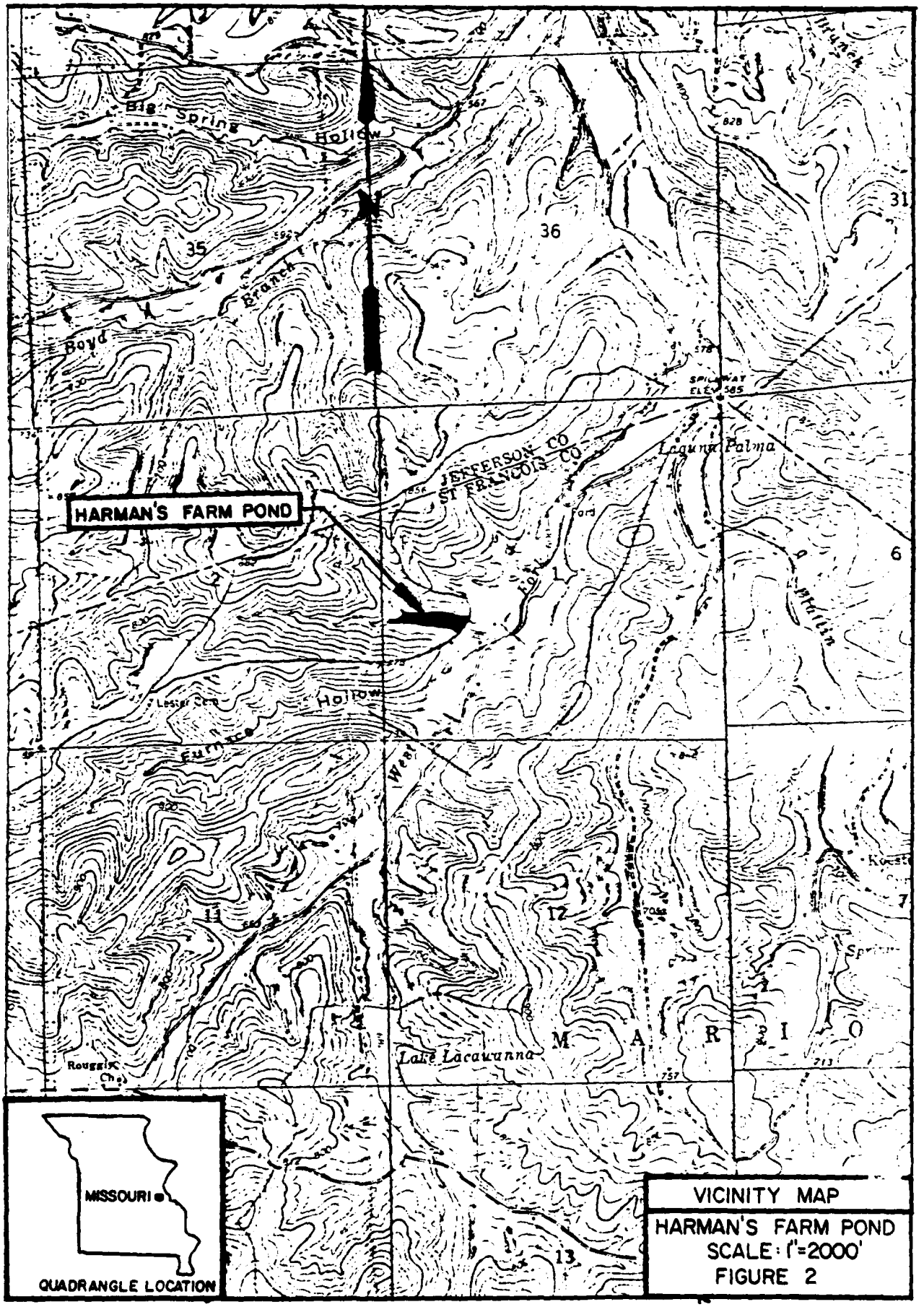
6. Institute a formal inspection program to be conducted at regular intervals by a registered professional engineer knowledgeable in earth dams. Records of all inspections and remedial actions should be kept and made available if necessary.

7. Institute a formal warning system to warn downstream residences of high spillway discharges or failure of the dam.

APPENDIX A

DRAWINGS


LAKE
FLOW
LOW SPOT
MEADOW
662.0'
655.8'
654.1'
655.2'
655.8'
SEEPAGE POOL
NO VISUAL FLOW
BRUSH IN SPILLWAY
AND ON SLOPES
PLAN
655.8'
654.1'
655.2'
655.8'
656.6'
10
1
1
650.7'
PROFILE
TOP OF DAM & SPILLWAY
HARMAN FARM POND
SCALE =1"=50'


HARMAN'S FARM POND
Big Spring
Hollow
Branch
Boyd
JEFFERSON CO
ST FRANCOIS CO
Laguna Palma
Hollow
Furnace
West
Lake Lacawanna
MARIO
MISSOURI
QUADRANGLE LOCATION
VICINITY MAP
HARMAN'S FARM POND
SCALE: 1"=2000'
FIGURE 2

APPENDIX B

HYDROLOGY AND HYDRAULICS

APPENDIX B

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors have not been applied. A 24 hour storm duration is assumed with total depth distributed over 6 hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6 hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6 hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use, and antecedent moisture conditions.

The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the outlet works, spillways, and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-storage capacity curve. The hydraulic capacity of the outlet works, spillways, and top of dam are defined by elevation-discharge curves.

Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

The above analysis has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed in the computer printout. Definitions of these variables are contained in the "User's Manual" for the computer program.

The inflow hydrograph was routed through the reservoir using HEC-1's Modified Puls option.

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME HARMAN'S FARM POND
I.D. NUMBER 30150
SHEET NO. 1 OF 4
BY OTM DATE 11-13-79

HARMAN'S FARM POND

DRAINAGE AREA

AREA = 0.26 SQ. MILES (U.S.G.S. 7.5-MIN. QUAD.)

UNIT HYDROGRAPH PARAMETERS

KIRPICH METHOD:

t_c = 0.23 HRS. LAG = 0.6 t_c = 0.16 HRS.

(FROM TIME OF CONCENTRATION NOMOGRAPH, KENTUCKY BUREAU OF HIGHWAYS)

WHERE LENGTH = 4,000 FT AND HEIGHT = 230 FT.

CURVE NUMBER METHOD:

$$\text{LAG (L)} = \frac{l^{0.8}(s+1)^{0.7}}{1900\ Y^{0.5}} = \frac{(4,000)^{0.8}(3.82)^{0.7}}{1900\ (6)^{0.5}}$$

$$= \frac{(761.5)(2.56)}{(4654)} = 0.42 \text{ HRS.}$$

WHERE l = GREATEST FLOW LENGTH IN FEET
$S = \frac{1000}{CN} - 10$ AND Y = AVERAGE SLOPE

(FROM NATIONAL ENGINEERING HANDBOOK, HYDROLOGY: SECTION 4 P. 15-7)

NOTE:
UTILIZED ANTECEDENT MOISTURE CONDITION III
HYDROLOGIC SOIL GROUP B
CN = 78
USE t_c = 0.16 HRS.

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EBENSBURG PENNSYLVANIA

DAM NAME HARMAN'S FARM POND
I.D. NUMBER 30150
SHEET NO. 2 OF 4
BY O.T.M. DATE 11-13-79

LOSS RATE AND BASE FLOW

STRTL = 1.0 INCH
CNSTL = 78
STRTQ = 1.5 CFS/MI^2
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.5

PROBABLE MAXIMUM STORM

FROM H.R. No. 33

P.M.P. INDEX RAINFALL (ZONE 7) = 25.5 INCHES
R_6 = 102%, R_{12} = 120% , R_{24} = 130 %

ELEVATION - AREA - CAPACITY RELATIONSHIP

SPILLWAY CREST ELEV. = 650.7'
WATER LEVEL ASSUMED TO BE AT ELEV. 650.0'
(BASED ON AERIAL PHOTOGRAPHS SUPPLIED BY THE ST. LOUIS DISTRICT C.O.E. AND U.S.G.S. 7.5-MIN. QUAD.)

ELEV. 650.7' , AREA = 5 AC.
ELEV. 660.0' , AREA = 7.5 AC.
ELEV. 680.0' , AREA = 10 AC.
} ESTIMATED FROM U.S.G.S. 7.5-MIN. QUAD.

FROM CONIC METHOD FOR RESERVOIR VOLUME. FLOOD HYDROGRAPH PACKAGE (H.E.C. 1). DAM SAFETY VERSION (USER'S MANUAL)

$H = 3V/A = 3(51)/5 = 30.6'$

∴ ELEV WHERE AREA EQUALS ZERO:
650.7' - 30.6' = 620.1' (USE 620')

WHERE VOL. (AC·FT) = 51 AC·FT (ESTIMATED)

ELEV. - AREA - CAPACITY CONTINUED :

#A	AREA (FT.)	0	5	7.5	10
#E	ELEV. (FT.)	620	650.7	660	680

SPILLWAY RATING CURVE

$$Q = 8.03\, c'\, h_v^{1/2} (h_p - h_v) [B + Z(h_p - h_v)]$$

WHERE $h_v = \dfrac{3(2Z h_p + B) - (16Z^2 h_p^2 + 16Z B h_p + 9B^2)^{1/2}}{10Z}$

AND $c' = 0.95$, $B = 16'$, $Z = 1.5$

FROM LOW DAMS, BY NATIONAL RESOURCE COMMITTEE WASHINGTON, D.C. (1938)

WATER AND WASTEWATER ENGINEERING (11-14 & 15) BY FAIR, GEYER & OKUM (1966)

ELEVATION (FT.)	h_p (FT.)	DISCHARGE* (Q) (CFS)
650.7	0	0
651.0	0.3	10
651.5	0.8	40
652.0	1.3	80
652.5	1.8	130
653.0	2.3	190
653.5	2.8	260
654.1	3.4	360
656.0	5.3	770
660.0	9.3	2150

* DISCHARGE VALUES ROUNDED TO NEAREST 10 CFS.

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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME HARMAN'S FARM POND
I.D. NUMBER 30150
SHEET NO. 4 OF 4
BY OTM DATE 11-13-79

OVERTOPPING PARAMETERS

DISCHARGE DETERMINED BY H.E.C.-1.

TOP OF DAM (LOW SPOT) = 654.1'
LENGTH OF DAM (EXCLUDING SPILLWAY) = 342'
COEFFICIENT OF DISCHARGE = 3.0 (BROAD CREST WEIR)
#L MAX. = 800'
#Y MAX. = 680'

```
OUTPUT3,P02,T60,CM330000.
USER,LRK100,LRK100,79012600113(OTM)
GET,HECPF/UN=EKSAPP.
CALL,HECPF,HEC1DB.
/EOR
A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF HARMANS FARM POND DAM
A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR (MISSOURI-30150)
B     288              5                                          3
B1      5
J       1        5     1
J1     .1       .2    .3      .5     1
K       0        1                                   1
K1        INFLOW
M       1        2  0.26                             1                  1
P             25.5   102     120    130
T                                                   .1        .78
W2            0.16
X    -1.5     -.05   2.5
K       1        2                                   1
K1        ROUTE
Y                              1      1
Y1      1                                       -650.7        .1
Y4  650.7      651   651.5   652   652.5    653   653.5   654.1    656    660
Y5      0       10      40    80     130    190     260     360    770   2150
SA      0        5     7.5    10
SE    620    650.7     660   680
SS  650.7
SD  654.1      3.0     1.5   342
SL     25      200     342   380     800
SV  654.1      655   656.6   660     680
K      99
/*EOF
```

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE= 79/11/01.
TIME= 05.50.44.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF HARMANS FARM POND DAM
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR (MISSOURI-301501)

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	3	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .10 .20 .30 .50 1.00

****

SUB-AREA RUNOFF COMPUTATION

INFLOW

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.26	0.00	.26	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	25.50	102.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-78.00	0.00	0.00

CURVE NO = -78.00 WETNESS = -1.00 EFFECT CN = 78.00

UNIT HYDROGRAPH DATA
Tc= 0.00 LAG= .36

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.50

[illegible] AREA= [illegible] LAG=

UNIT HYDROGRAPH 32 END-OF-PERIOD ORDINATES, Tc= [illegible] LAG= .36 VOL= 1.00

MOORE CLEAN PRINT® NO. 3,016,309; 3,429,827 141710 PRINTED IN USA

3004. 30. 594. 0. 3664. 3103. 1614. 824. 424. 214. 114. 64.

Q MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.22	.19	.03	139.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.22	.19	.03	219.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.22	.19	.02	296.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.22	.19	.02	341.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.22	.19	.02	365.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.22	.20	.02	378.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.22	.20	.02	386.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.22	.20	.02	391.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.22	.20	.02	394.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.22	.20	.02	397.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.22	.20	.02	399.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.22	.20	.02	401.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.26	.24	.02	411.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.26	.24	.02	436.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.26	.24	.02	460.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.26	.24	.02	475.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.26	.24	.02	483.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.26	.24	.01	488.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.26	.25	.01	491.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.26	.25	.01	493.
1.01	1.45	21	.01	0.00	.01	0.	1.01	13.45	165	.26	.25	.01	495.
1.01	1.50	22	.01	0.00	.01	0.	1.01	13.50	166	.26	.25	.01	496.
1.01	1.55	23	.01	0.00	.01	0.	1.01	13.55	167	.26	.25	.01	497.
1.01	2.00	24	.01	0.00	.01	0.	1.01	14.00	168	.26	.25	.01	498.
1.01	2.05	25	.01	0.00	.01	0.	1.01	14.05	169	[illegible]	[illegible]	.01	512.
1.01	2.10	26	.01	0.00	.01	0.	1.01	14.10	170	[illegible]	[illegible]	.01	550.
1.01	2.15	27	.01	0.00	.01	0.	1.01	14.15	171	[illegible]	[illegible]	.01	587.
1.01	2.20	28	.01	0.00	.01	0.	1.01	14.20	172	.33	.31	.01	608.
1.01	2.25	29	.01	0.00	.01	0.	1.01	14.25	173	.33	.31	.01	619.
1.01	2.30	30	.01	0.00	.01	0.	1.01	14.30	174	.33	.31	.01	625.
1.01	2.35	31	.01	0.00	.01	0.	1.01	14.35	175	.33	.31	.01	629.
1.01	2.40	32	.01	0.00	.01	0.	1.01	14.40	176	.33	.32	.01	631.
1.01	2.45	33	.01	0.00	.01	0.	1.01	14.45	177	.33	.32	.01	632.
1.01	2.50	34	.01	0.00	.01	0.	1.01	14.50	178	.33	.32	.01	634.
1.01	2.55	35	.01	0.00	.01	0.	1.01	14.55	179	.33	.32	.01	635.
1.01	3.00	36	.01	0.00	.01	0.	1.01	15.00	180	.33	.32	.01	635.
1.01	3.05	37	.01	0.00	.01	0.	1.01	15.05	181	.20	.19	.01	610.
1.01	3.10	38	.01	0.00	.01	0.	1.01	15.10	182	.40	.39	.01	577.
1.01	3.15	39	.01	0.00	.01	0.	1.01	15.15	183	.40	.39	.01	622.
1.01	3.20	40	.01	.00	.01	0.	1.01	15.20	184	.59	.58	.01	732.
1.01	3.25	41	.01	.00	.01	0.	1.01	15.25	185	.69	.68	.01	909.
1.01	3.30	42	.01	.00	.01	0.	1.01	15.30	186	1.68	1.65	.03	1300.
1.01	3.35	43	.01	.00	.01	0.	1.01	15.35	187	2.77	2.73	.04	2228.
1.01	3.40	44	.01	.00	.01	0.	1.01	15.40	188	1.09	1.07	.01	3142.
1.01	3.45	45	.01	.00	.01	1.	1.01	15.45	189	.69	.68	.01	3033.
1.01	3.50	46	.01	.00	.01	1.	1.01	15.50	190	.59	.59	.01	2362.
1.01	3.55	47	.01	.00	.01	1.	1.01	15.55	191	.40	.39	.00	1779.
1.01	4.00	48	.01	.00	.01	2.	1.01	16.00	192	.40	.39	.00	1353.
1.01	4.05	49	.01	.00	.01	2.	1.01	16.05	193	.30	.30	.00	1062.
1.01	4.10	50	.01	.00	.01	2.	1.01	16.10	194	.30	.30	.00	864.
1.01	4.15	51	.01	.00	.01	2.	1.01	16.15	195	.30	.30	.00	740.
1.01	4.20	52	.01	.00	.01	3.	1.01	16.20	196	.30	.30	.00	673.
1.01	4.25	53	.01	.00	.01	3.	1.01	16.25	197	.30	.30	.00	638.
1.01	4.30	54	.01	.00	.01	3.	1.01	16.30	198	.30	.30	.00	619.

1.01	6.35	55	.01	.00	.01	3.	1.01	16.35	199	.30	.30	.00	611.
1.01	6.40	56	.01	.00	.01	4.	1.01	16.40	200	.30	.30	.00	607.
1.01	6.45	57	.01	.00	.01	4.	1.01	16.45	201	.30	.30	.00	606.
1.01	6.50	58	.01	.00	.01	4.	1.01	16.50	202	.30	.30	.00	605.
1.01	6.55	59	.01	.00	.01	4.	1.01	16.55	203	.30	.30	.00	605.
1.01	7.00	60	.01	.00	.01	4.	1.01	17.00	204	.30	.30	.00	605.
1.01	7.05	61	.01	.00	.01	5.	1.01	17.05	205	.24	.24	.00	592.
1.01	7.10	62	.01	.00	.01	5.	1.01	17.10	206	.24	.24	.00	594.
1.01	7.15	63	.01	.00	.01	5.	1.01	17.15	207	.24	.24	.00	517.
1.01	7.20	64	.01	.00	.01	5.	1.01	17.20	208	.24	.24	.00	497.
1.01	7.25	65	.01	.00	.01	6.	1.01	17.25	209	.24	.24	.00	487.
1.01	7.30	66	.01	.00	.01	6.	1.01	17.30	210	.24	.24	.00	481.
1.01	7.35	67	.01	.00	.01	6.	1.01	17.35	211	.24	.24	.00	479.
1.01	7.40	68	.01	.00	.01	6.	1.01	17.40	212	.24	.24	.00	477.
1.01	7.45	69	.01	.00	.01	6.	1.01	17.45	213	.24	.24	.00	477.
1.01	7.50	70	.01	.00	.01	7.	1.01	17.50	214	.24	.24	.00	476.
1.01	7.55	71	.01	.00	.01	7.	1.01	17.55	215	.24	.24	.00	476.
1.01	8.00	72	.01	.00	.01	7.	1.01	18.00	216	.24	.24	.00	476.
1.01	8.05	73	.06	.02	.05	10.	1.01	18.05	217	.02	.02	.00	432.
1.01	8.10	74	.06	.02	.04	19.	1.01	18.10	218	.02	.02	.00	304.
1.01	8.15	75	.06	.02	.04	28.	1.01	18.15	219	.02	.02	.00	181.
1.01	8.20	76	.06	.02	.04	35.	1.01	18.20	220	.02	.02	.00	148.
1.01	8.25	77	.06	.02	.04	39.	1.01	18.25	221	.02	.02	.00	135.
1.01	8.30	78	.06	.03	.04	43.	1.01	18.30	222	.02	.02	.00	123.
1.01	8.35	79	.06	.03	.04	47.	1.01	18.35	223	.02	.02	.00	115.
1.01	8.40	80	.06	.03	.04	50.	1.01	18.40	224	.02	.02	.00	103.
1.01	8.45	81	.06	.02	.03	53.	1.01	18.45	225	.02	.02	.00	94.
1.01	8.50	82	.06	.03	.03	55.	1.01	18.50	226	.02	.02	.00	86.
1.01	8.55	83	.06	.03	.03	58.	1.01	18.55	227	.02	.02	.00	78.
1.01	9.00	84	.06	.03	.03	60.	1.01	19.00	228	.02	.02	.00	71.
1.01	9.05	85	.06	.03	.03	62.	1.01	19.05	229	.02	.02	.00	65.
1.01	9.10	86	.06	.03	.03	64.	1.01	19.10	230	.02	.02	.00	59.
1.01	9.15	87	.06	.04	.03	66.	1.01	19.15	231	.02	.02	.00	54.
1.01	9.20	88	.06	.04	.03	68.	1.01	19.20	232	.02	.02	.00	49.
1.01	9.25	89	.06	.04	.03	70.	1.01	19.25	233	.02	.02	.00	45.
1.01	9.30	90	.06	.04	.03	72.	1.01	19.30	234	.02	.02	.00	42.
1.01	9.35	91	.06	.04	.03	73.	1.01	19.35	235	.02	.02	.00	42.
1.01	9.40	92	.06	.04	.02	75.	1.01	19.40	236	.02	.02	.00	42.
1.01	9.45	93	.06	.04	.02	76.	1.01	19.45	237	.02	.02	.00	42.
1.01	9.50	94	.06	.04	.02	78.	1.01	19.50	238	.02	.02	.00	42.
1.01	9.55	95	.06	.04	.02	79.	1.01	19.55	239	.02	.02	.00	42.
1.01	10.00	96	.06	.04	.02	81.	1.01	20.00	240	.02	.02	.00	42.
1.01	10.05	97	.06	.04	.02	82.	1.01	20.05	241	.02	.02	.00	42.
1.01	10.10	98	.06	.04	.02	83.	1.01	20.10	242	.02	.02	.00	42.
1.01	10.15	99	.06	.04	.02	84.	1.01	20.15	243	.02	.02	.00	42.
1.01	10.20	100	.06	.04	.02	86.	1.01	20.20	244	.02	.02	.00	42.
1.01	10.25	101	.06	.04	.02	87.	1.01	20.25	245	.02	.02	.00	42.
1.01	10.30	102	.06	.04	.02	88.	1.01	20.30	246	.02	.02	.00	42.
1.01	10.35	103	.06	.05	.02	89.	1.01	20.35	247	.02	.02	.00	42.
1.01	10.40	104	.06	.05	.02	90.	1.01	20.40	248	.02	.02	.00	42.
1.01	10.45	105	.06	.05	.02	91.	1.01	20.45	249	.02	.02	.00	42.
1.01	10.50	106	.06	.05	.02	92.	1.01	20.50	250	.02	.02	.00	42.
1.01	10.55	107	.06	.05	.02	92.	1.01	20.55	251	.02	.02	.00	42.
1.01	11.00	108	.06	.05	.02	93.	1.01	21.00	252	.02	.02	.00	42.
1.01	11.05	109	.06	.05	.02	94.	1.01	21.05	253	.02	.02	.00	42.
1.01	11.10	110	.06	.05	.02	95.	1.01	21.10	254	.02	.02	.00	42.
1.01	11.15	111	.06	.05	.02	96.	1.01	21.15	255	.02	.02	.00	42.
1.01	11.20	112	.06	.05	.02	96.	1.01	21.20	256	.02	.02	.00	42.
1.01	11.25	113	.06	.05	.01	97.	1.01	21.25	257	.02	.02	.00	42.
1.01	11.30	114	.06	.05	.01	98.	1.01	21.30	258	.02	.02	.00	42.

1.01	9.35	115	.06	.05	.01	98.	1.01	21.35	259	.02	.02	.00	42.
1.01	9.40	116	.06	.05	.01	99.	1.01	21.40	260	.02	.02	.00	42.
1.01	9.45	117	.06	.05	.01	100.	1.01	21.45	261	.02	.02	.00	42.
1.01	9.50	118	.06	.05	.01	100.	1.01	21.50	262	.02	.02	.00	42.
1.01	9.55	119	.06	.05	.01	101.	1.01	21.55	263	.02	.02	.00	42.
1.01	10.00	120	.06	.05	.01	101.	1.02	22.00	264	.02	.02	.00	42.
1.01	10.05	121	.06	.05	.01	102.	1.01	22.05	265	.02	.02	.00	42.
1.01	10.10	122	.06	.05	.01	103.	1.01	22.10	266	.02	.02	.00	42.
1.01	10.15	123	.06	.05	.01	103.	1.01	22.15	267	.02	.02	.00	42.
1.01	10.20	124	.06	.05	.01	104.	1.01	22.20	268	.02	.02	.00	42.
1.01	10.25	125	.06	.05	.01	104.	1.01	22.25	269	.02	.02	.00	42.
1.01	10.30	126	.06	.05	.01	104.	1.01	22.30	270	.02	.02	.00	42.
1.01	10.35	127	.06	.05	.01	105.	1.01	22.35	271	.02	.02	.00	42.
1.01	10.40	128	.06	.05	.01	105.	1.01	22.40	272	.02	.02	.00	42.
1.01	10.45	129	.06	.05	.01	106.	1.01	22.45	273	.02	.02	.00	42.
1.01	10.50	130	.06	.05	.01	106.	1.01	22.50	274	.02	.02	.00	42.
1.01	10.55	131	.06	.05	.01	107.	1.01	22.55	275	.02	.02	.00	42.
1.01	11.00	132	.06	.05	.01	107.	1.01	23.00	276	.02	.02	.00	42.
1.01	11.05	133	.06	.05	.01	107.	1.01	23.05	277	.02	.02	.00	42.
1.01	11.10	134	.06	.05	.01	108.	1.01	23.10	278	.02	.02	.00	42.
1.01	11.15	135	.06	.05	.01	108.	1.01	23.15	279	.02	.02	.00	42.
1.01	11.20	136	.06	.05	.01	109.	1.01	23.20	280	.02	.02	.00	42.
1.01	11.25	137	.06	.05	.01	109.	1.01	23.25	281	.02	.02	.00	42.
1.01	11.30	138	.06	.05	.01	109.	1.01	23.30	282	.02	.02	.00	42.
1.01	11.35	139	.06	.05	.01	110.	1.01	23.35	283	.02	.02	.00	42.
1.01	11.40	140	.06	.05	.01	110.	1.01	23.40	284	.02	.02	.00	42.
1.01	11.45	141	.06	.06	.01	110.	1.01	23.45	285	.02	.02	.00	42.
1.01	11.50	142	.06	.06	.01	110.	1.01	23.50	286	.02	.02	.00	42.
1.01	11.55	143	.06	.06	.01	111.	1.01	23.55	287	.02	.02	.00	42.
1.01	12.00	144	.06	.06	.01	111.	1.02	0.00	288	.02	.02	.00	42.
								SUM	33.15	29.99	3.16	60723.	
									1 842.11	762.11	80.11	1719.481	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3142.	699.	211.	211.	60733.
CMS	89.	20.	6.	6.	1720.
INCHES		25.01	30.18	30.18	30.18
MM		635.29	766.55	766.55	766.55
AC-FT		347.	418.	418.	418.
THOUS CU M		428.	516.	516.	516.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	314.	70.	21.	21.	6073.
CMS	9.	2.	1.	1.	172.
INCHES		2.50	3.02	3.02	3.02
MM		63.53	76.66	76.66	76.66
AC-FT		35.	42.	42.	42.
THOUS CU M		43.	52.	52.	52.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
[illegible]	[illegible]	42.	42.	12167.

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CMS	18.	4.	1.	1.	344.
INCHES		5.00	6.04	6.04	6.04
MM		127.06	153.31	153.31	153.31
AC-FT		69.	84.	84.	84.
THOUS CU M		86.	103.	103.	103.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	942.	210.	63.	63.	18220.
CMS	27.	6.	2.	2.	516.
INCHES		7.50	9.05	9.05	9.05
MM		190.59	229.97	229.97	229.97
AC-FT		104.	125.	125.	125.
THOUS CU M		128.	155.	155.	155.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1571.	320.	105.	105.	30366.
CMS	44.	10.	3.	3.	860.
INCHES		12.51	15.09	15.09	15.09
MM		317.64	383.28	383.28	383.28
AC-FT		173.	209.	209.	209.
THOUS CU M		214.	258.	258.	258.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3142.	699.	211.	211.	60733.
CMS	89.	20.	6.	6.	1720.
INCHES		25.01	30.18	30.18	30.18
MM		635.29	766.55	766.55	766.55
AC-FT		347.	418.	418.	418.
THOUS CU M		428.	516.	516.	516.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
[illegible]	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-621.	-1

STAGE	650.70	651.00	651.50	652.00	652.50	653.00	653.50	654.10	656.00
FLOW	0.00	10.00	40.00	80.00	130.00	190.00	260.00	360.00	770.00
SURFACE AREA=		0.	5.	8.	10.				
CAPACITY=		0.	51.	109.	283.				
ELEVATION=		620.	651.	660.	680.				

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
650.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
654.1	3.0	1.5	342.

CREST LENGTH	25.	200.	342.	380.	800.
AT OR BELOW ELEVATION	654.1	655.0	656.6	660.0	680.0

STATION 2. PLAN 1. RATIO 1

PEAK OUTFLOW IS 153. AT TIME 16.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	153.	66.	21.	21.	5962.
CMS	4.	2.	1.	1.	169.
INCHES		2.36	2.96	2.96	2.96
MM		59.90	75.25	75.25	75.25
AC-FT		33.	41.	41.	41.
THOUS CU M		40.	51.	51.	51.

STATION 2. PLAN 1. RATIO 2

PEAK OUTFLOW IS 348. AT TIME 15.92 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	348.	134.	41.	41.	11248.
CMS	10.	4.	1.	1.	338.
INCHES		4.79	5.94	5.94	5.94
MM		121.61	150.81	150.81	150.81
AC-FT		66.	82.	82.	82.
THOUS CU M		82.	101.	101.	101.

STATION 2, PLAN 1, RATIO 3

PEAK OUTFLOW IS 688. AT TIME 15.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	688.	202.	62.	62.	17963.
CMS	19.	6.	2.	2.	509.
INCHES		7.24	8.93	8.93	8.93
MM		183.79	226.72	226.72	226.72
AC-FT		100.	124.	124.	124.
THOUS CU M		124.	153.	153.	153.

STATION 2, PLAN 1, RATIO 4

PEAK OUTFLOW IS 1437. AT TIME 15.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1437.	340.	104.	104.	30004.
CMS	41.	10.	3.	3.	850.
INCHES		12.16	14.91	14.91	14.91
MM		308.83	378.71	378.71	378.71
AC-FT		169.	207.	207.	207.
THOUS CU M		208.	255.	255.	255.

STATION 2, PLAN 1, RATIO 5

PEAK OUTFLOW IS 3110. AT TIME 15.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3110.	687.	209.	209.	60117.
CMS	88.	19.	6.	6.	1702.
INCHES		24.57	29.87	29.87	29.87
MM		624.06	758.78	758.78	758.78
AC-FT		341.	414.	414.	414.
THOUS CU M		420.	511.	511.	511.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS				
				RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .50	RATIO 5 1.00
HYDROGRAPH AT	1	.26 (.67)	1	314. (8.90)	628. (17.79)	942. (26.69)	1571. (44.48)	3142. (88.96)
ROUTED TO	2	.26 (.67)	1	153. (4.32)	348. (9.86)	688. (19.48)	1437. (40.69)	3110. (88.06)

SUMMARY OF DAM SAFETY ANALYSIS

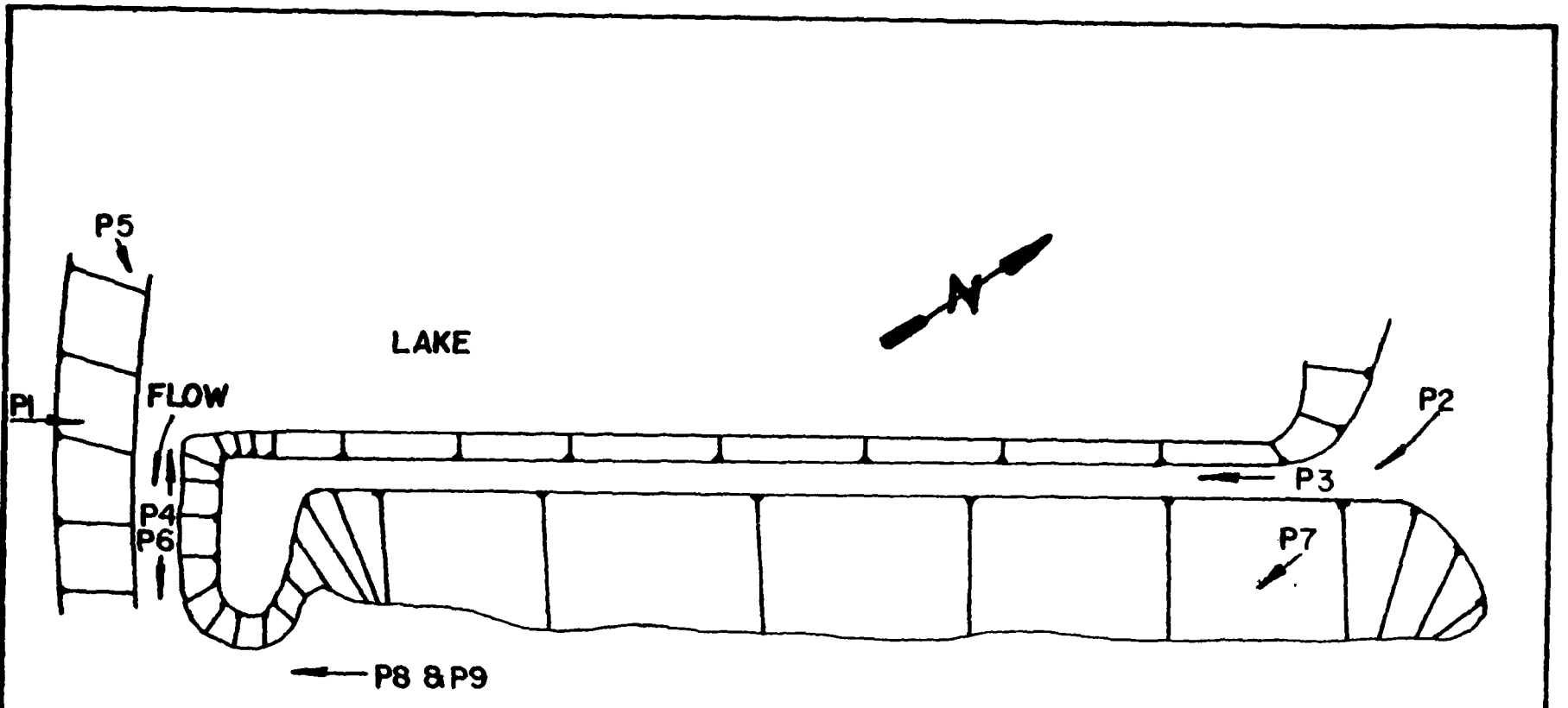
PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	650.70	650.70	654.10
STORAGE	51.	51.	70.
OUTFLOW	0.	0.	360.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	652.69	0.00	62.	153.	0.00	16.00	0.00
.20	654.03	0.00	69.	348.	0.00	15.92	0.00
.30	654.86	.76	74.	688.	.67	15.83	0.00
.50	655.60	1.50	79.	1437.	1.17	15.75	0.00
1.00	656.56	2.46	85.	3110.	5.17	15.75	0.00

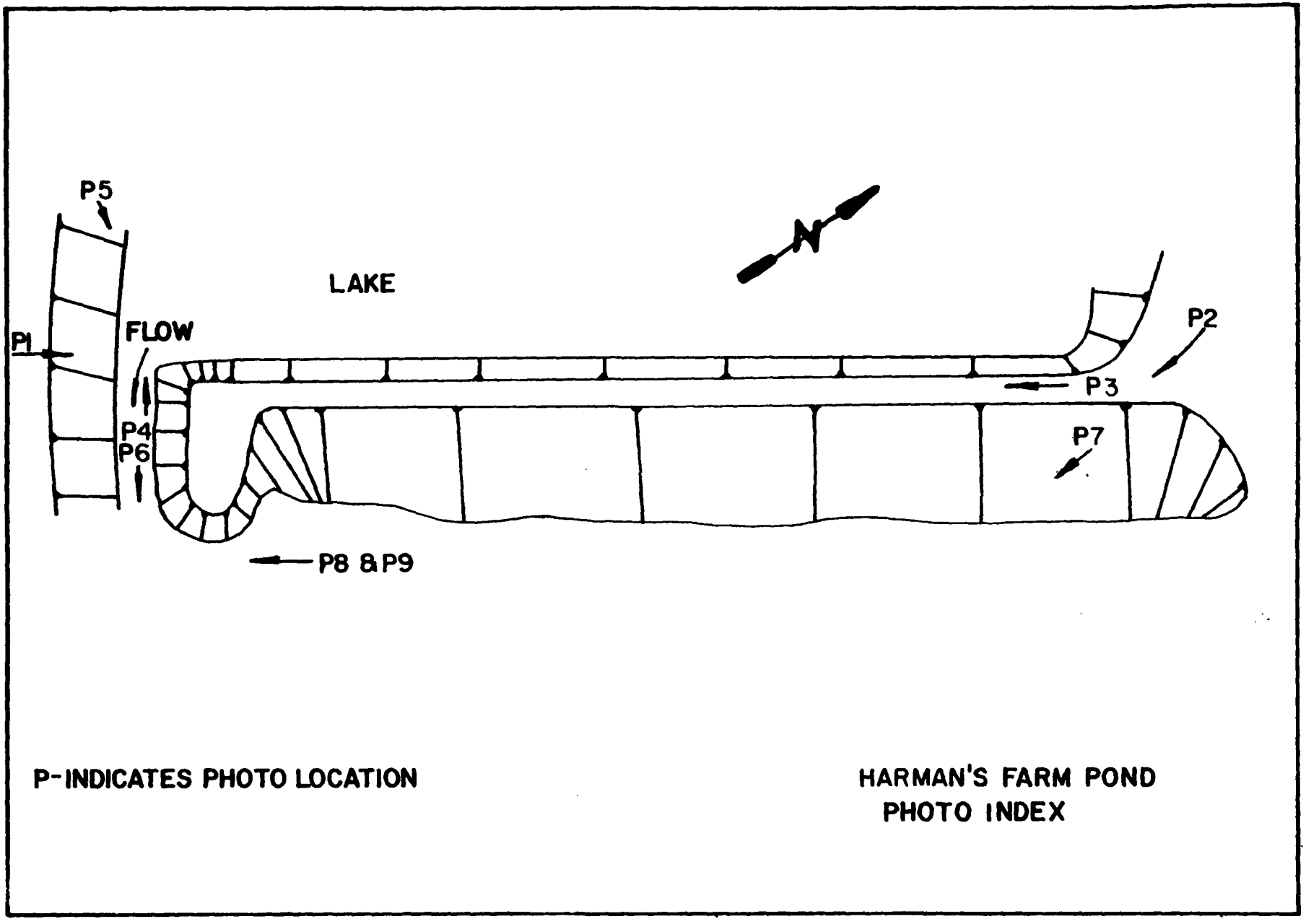
APPENDIX C

PHOTOGRAPHS



P-INDICATES PHOTO LOCATION

HARMAN'S FARM POND
PHOTO INDEX



P-INDICATES PHOTO LOCATION

HARMAN'S FARM POND
PHOTO INDEX

Photograph No. 2
Downstream slope.

Photograph No. 3
View of crest from left abutment.

Photograph No. 4
Spillway approach channel.

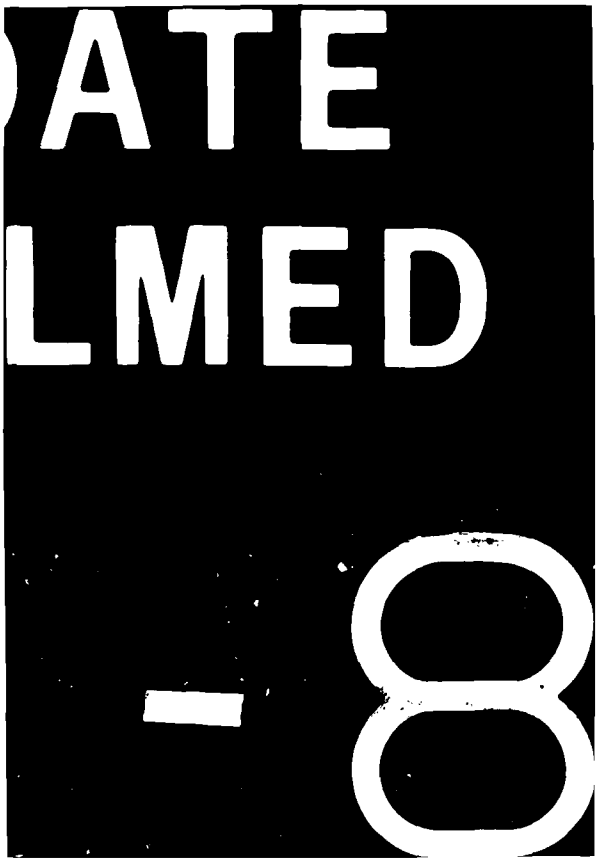
Photograph No. 5
Spillway exit channel.

Photograph No. 6
Spillway discharge channel.

Photograph No. 7
Immediate downstream area.

Photograph No. 8
Spillway exit channel beyond toe of dam.

Photograph No. 9
Spillway exit channel beyond toe of dam.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